



ON TWO CASES OF TRAUMATIC RUPTURE OF
THE COLON,

WITH SOME REMARKS ON THE CASES OF RUPTURE OF THE IN-
TESTINE TREATED IN THE WARDS OF ST. THOMAS'S
HOSPITAL, LONDON, BETWEEN THE YEARS
1889 AND 1898, INCLUSIVE.

By GEORGE HENRY MAKINS, F.R.C.S.,

OF LONDON,

SURGEON TO ST. THOMAS'S HOSPITAL.

DURING the past three years it has fallen to my lot to treat two cases of rupture of the ascending colon, and these, though differing widely in their course and nature, both ended successfully.

The first case has been already included in a short account of three abdominal injuries published in the *St. Thomas's Hospital Reports*; but in preparing the notes of the second case for publication, it occurred to me that it would materially add to its value if I took the opportunity of adding to my account some remarks on the subject in general, gleaned from the experience gained in these injuries, since a definite line of treatment has been the rule in the hospital.

The series utilized for remark commences from the date of the already classical case of Mr. Croft, the first rupture of the intestine successfully treated by suture, and includes all those which have since been under treatment in the hospital. Many of these have been already published as isolated cases, but no attempt has been made to glean general information from them, and it is evident that since the adoption of abdominal section as a routine treatment we are in the possession of a considerable amount of knowledge as to the early condition

of the abdominal cavity after such injuries, which was wanting when the post-mortem room furnished the sole field of study. On some points as much information as might be wished is wanting, as the result of the notes of the cases being the work of different persons, and not having been made with any special object in view; none the less, it seems to me that several important points are suggested by them, and that, in the present state of our knowledge, any contribution tending to throw light on a class of injury which has so lately proved itself capable of successful treatment will be acceptable.

I will first detail the history of my most recent case, which is shortly as follows:

A healthy man, aged twenty-six years, while steadyng a log, about three feet in diameter, on the table of a circular saw, received a blow in the right flank as a result of the log being thrown suddenly backward by the machine.

The patient was thrown down, but did not lose consciousness; in a few minutes he commenced to vomit, and this symptom continued during the forty-five minutes employed in bringing him up to the hospital.

On his arrival he was evidently in great pain, his face was pale although not blanched, the eyelids were half closed, and his skin was moist with perspiration. When laid on the couch he seemed dazed, but answered questions intelligently. The breathing was shallow and rapid, occasionally accompanied by a half-suppressed groan; he lay with the knees drawn up; the pulse was 88, regular, and of good volume; the temperature slightly subnormal.

On inspection of the abdomen a slight graze, about two inches in length, was seen extending obliquely downward and inward from a little above the anterior superior spine of the ilium, in the line of Poupart's ligament. The abdominal wall was rigid and scarcely moved with respiration. There was no distension. General abdominal tenderness was complained of on palpation, but the most tender spot was in the right iliac region. No emphysema was present. On percussion, the liver dulness was normal, but there was slight impairment of resonance in the right loin. A specimen of clear normal urine was removed with the

catheter. Matter vomited on admission consisted of partly digested food and was clearly gastric in origin.

During the next six hours the condition increased in gravity, the patient continued to vomit frequently, the voided matter assuming a green color, but remaining inoffensive in odor; the rigidity of the abdominal wall varied a little in degree at times, and no evidence of free fluid in the abdominal cavity developed. The face became flushed and anxious, and the patient sweated freely, while the pulse increased in frequency, at the same time losing in strength.

I was called to see him at 10 P.M., and an hour later he was brought into the operating theatre.

A median incision was made below the umbilicus and the belly opened. The presenting omentum was slightly ecchymosed, and a small quantity of muddy-brown fluid escaped; as the pelvis was reached the latter became distinctly faecal in odor, and in this region the intestines were coated with thick patches of plastic lymph. Exposure of the cæcum led to the evacuation of a blood clot of the size and shape of a finger, and this portion of the colon was of a dark-red color from ecchymosis and congestion. On the anterior aspect of the cæcum the peritoneal coat was rent in a longitudinal direction for a length of two inches, while at its lateral aspect, at the junction with the ascending colon, a somewhat valvular opening, about three-fourths of an inch long, was found to perforate all the coats of the bowel. From the latter opening a small amount of faecal matter had escaped, and gas passed out freely, while a track of cellular emphysema extended along the side and back of the colon, and a considerable retroperitoneal haemorrhage was found in the iliac region. The neighboring parts of the peritoneum were cleansed by sponging, and both the incomplete and the complete rents repaired by the passage of Lembert stitches. The bruised portion of the omentum was then removed, and the belly cavity generally flushed with sterilized water. Bearing in mind the impossibility of rendering aseptic the track of cellular emphysema in direct continuity with a considerable retroperitoneal haemorrhage, it was thought well to introduce a large gauze plug, and bring it out at the lower angle of the central line incision. For convenience in manipulation it had been found necessary to extend the original incision across the right rectus muscle, and this, together with the part of the

wound not occupied by the plug, was now united with sunk sutures.

Little shock was noted during the operation, but after removal to bed the pulse rose to 160, and a very restless night was passed. During the night the temperature rose to 100° F., but there was no return of the vomiting, and small quantities of warm water were allowed to be swallowed.

During the second day a general improvement was noted, the pulse falling to 82, and the patient complaining little. The belly was soft and the respiratory movements, though shallow, were not entirely thoracic. In the afternoon a little milk was given, but it was not retained, and a pint of warm water was therefore injected into the rectum to relieve thirst. There was little pain or tenderness. Twenty-four ounces of normal urine were passed. The wound was dressed and the plug withdrawn, and as the latter was odorless, and no escape of fluid followed its withdrawal, it was not replaced, and the wound was completely closed.

In the evening the temperature rose to 101.5° F., the pulse again increased to 120, the respirations rising to 32. A fair night was passed, however, and on the morning of the third day his condition was most satisfactory, the pulse having again fallen to 86, the respirations to 28, and the temperature to 100°.

Milk and water was now given by the mouth, but it was occasionally vomited, and during the day distention of the abdomen rapidly increased.

In the afternoon of this day the patient's appearance suddenly altered greatly for the worse, the face became anxious and somewhat livid, distention was marked, and he complained of pain. The question of the failure of the suture or the development of peritoneal septicæmia was now considered, and the latter decided upon; two and a half drachms of sulphate of magnesia was therefore administered by mouth, and retained. A long tube passed into the rectum failed to give any relief, and as the bowels did not act, this was followed by the administration of an enema of soap and water, after which a free evacuation occurred, giving much relief. Pain, however, continued, and nourishment was taken badly. The amount of urine secreted gradually increased in quantity, amounting to thirty-eight and thirty-four ounces for the two days.

During the fourth and fifth days little improvement was

noted, the anxious expression was retained, and there was still some distention; the upper part of the abdomen, however, became quite flaccid, and moved freely with respiration. The pulse ranged between 68 and 80, the temperature averaged about 100° F., and a fair quantity of urine was passed. A great aversion to milk was developed, but eggs, Valentine's meat-juice, and brandy were taken well, and there was no sickness. During both these days a drachm of sulphate of magnesia was given every four hours, but the bowels did not again act until the night of the fifth day, when they were open five times, and fifty-four ounces of urine were passed.

On the sixth day a very marked improvement was noted, the patient awoke without the anxious expression, the abdomen was flaccid and moved freely, and the only unpleasant symptom consisted in tenderness and impairment of resonance in the right iliac fossa.

On the morning of the seventh day there was fluctuation evident at the lower angle of the abdominal wound, and a director inserted here released a considerable quantity of foul-smelling pus, which welled up upon pressure in the right iliac region.

From this date no further symptoms were developed, the temperature, pulse, and respirations became normal, the bowels acted daily, a normal amount of urine was secreted, and strength was rapidly regained.

The wound ceased to discharge, and healed at the end of a fortnight, leaving some induration, which, however, also disappeared before he left the hospital, on the fortieth day.

The man has since remained in good health, and resumed his ordinary occupation.

The above case offers some points of special interest, and the more so since the course to recovery was not a continuously successful one.

The history is an unusual one, the force being severe and applied to a strictly local area, the latter, moreover, being marked by a distinct local abrasion.

The patient was fortunate in coming early under observation, the operation being undertaken seven hours after the injury, and this was the more important, since the escape of

intestinal contents was somewhat freer than is apparently usually the case.

The indications for exploration were the nature and history of the injury, frequent and early vomiting, early development of rigidity of the abdominal wall, local tenderness, and impairment of resonance in the right iliac region, the absence of definite signs of injury to the urinary bladder or solid viscera, combined with the evidence of serious injury as indicated by the degree of shock, abdominal pain, rising pulse, general pallor, and perspiration.

A median incision was chosen; as events turned out, one in the right iliac fossa would, perhaps, have been preferable, as the wound had to be extended laterally.

On opening the abdomen, the striking points were first the well-marked faecal odor of the fluid met with, and, secondly, the large amount of plastic lymph developed on the surface of the coils of small intestine, lying in the right iliac region, and the pelvis on the right side.

The rent in the bowel was in some respects a peculiar one; both aspects of the tube were injured, the anterior, probably the one first impinged upon by the force of the blow, had escaped with a longitudinal rent of the peritoneal covering, while the posterior one, as being directly driven against the ilium, had given way entirely at the point of reflection of the peritoneum to the abdominal wall, no doubt a weak spot, as the meeting-place of two parts of the intestinal coats of varying strength.

As was shown by the presence of emphysema of the cellular tissue of the ascending colon at the time of operation, and by the subsequent suppuration, this location of the rupture was most unfortunate, both as rendering immediate cleansing impossible (since it is evident that where air could permeate septic fluids could also readily pass, and this into a tract of tissue already occupied in part by extravasated blood, a most favorable medium for the development of septic organisms) and as rendering future suppuration almost certain. In this respect, I think, there can be no doubt that an uncom-

plicated intraperitoneal rupture is to be preferred to a mixed one, such as we are considering.

The method of suture chosen is, I think, the best, and preferable to any in which portions of the bowel are cut away, except in instances where wide-spread, severe contusion or complete transverse rupture has occurred.

The method of cleansing—although in the circumstances of this case defective—is also to be preferred, as a rule,—viz., first dry sponging of the evidently fouled area, followed by irrigation of the neighboring parts with sterile water, or preferably sterilized normal saline solution.

The introduction of a gauze plug, although sometimes unnecessary, was clearly indicated in this case. The only error was in not replacing it at the time of the first dressing, or, at any rate, leaving it longer in place. None the less, I think the plug must have the credit of having determined the course taken by the pus to the lower angle of the wound, where it was eventually evacuated.

The last point to which I will refer is the treatment of the peritoneal septicæmia by the administration of a saline purgative. I attribute great importance to this, and shall refer to it again in a later part of the paper.

I will now pass to the consideration of some general points raised by the examination of the details of the twenty-one cases that have come under treatment in St. Thomas's Hospital during the past ten years.

Frequency of Occurrence of Ruptures of the Intestine.—During the ten years under consideration, 8153 cases of injury to various parts of the body were treated in the hospital, and of these 292, or 3.59 per cent., were injuries of varying degrees of severity of the abdomen.

The subjoined table shows that of the whole number of abdominal injuries eighty-nine were ruptures either of abdominal viscera or the urinary bladder, thus 30.47 per cent.

Further, that of the eighty-nine cases, twenty-one—or 23.59 per cent.—were ruptures of the intestine.

The order of frequency of the visceral ruptures comes

out as follows: Kidney, 39.32 per cent.; intestine, 23.59 per cent.; liver, 16.85 per cent.; spleen, 11.23 per cent.; bladder, 5.61 per cent.; mesentery, 3.27 per cent. The relative frequency of injury to the kidney, it need hardly be pointed out, is probably due to the fact that the organ may suffer whichever flank is injured.

TABLE SHOWING TOTAL NUMBER OF INJURIES FROM 1889 TO 1898.

Year.	Total Injuries	Abdominal Injuries.	Liver.	Kidney.	Spleen.	Bladder.	Mesentery.	Intestine.	Wound of Intestines.
1898	815	43	3	6	.	1	.	6	..
1897	787	34	3	4	2	1	.	3	1
1896	772	30	3	4	2	.	2	1	1
1895	816	46	1	9	4	1	.	3	..
1894	901	25	2	2	1	1	.	1	1
1893	932	32	1	3	.	.	1	..	..
1892	779	17	1	2	1	.	.	2	..
1891	809	34	1	1	.	.	.	2	..
1890	749	10	..	..	..	..	.	2	..
1889	793	21	..	4	.	..	.	2	1
Total . .	8153	292	15	35	10	4	3	22	4
Per cent. . .	..	3.59	16.85	39.32	11.23	5.61	3.37	23.59	

Causation.—The series throws little fresh light on this point, as in the older collections of cases we find that the one factor of importance is that the violence should be severe and localized in its action to a small area. Thus, of twenty-one cases, six were the result of kicks by horses; five patients were run over; four fell (one onto an anvil, one with a second man across his belly, one from a window across an iron railing, and one from a van); two patients were caught between buffers; one was struck by the end of a plank on a sawing machine; one was pinned by the pole of a van against a wall; one was struck by a falling box; and one was caught and rolled between two passing railway trucks.

Part of the Intestine Injured.—On this point the present series throws a very important etiological light. In the older series the relative degree of fixation of the bowel has always been upheld as one of the most important factors, and

an immense numerical proportion of instances of rupture of the small intestine has been recorded. Thus, of 116 cases collected by Curtis, no less than 112 are ruptures of the small gut. That the small intestine, by reason of its comparatively exposed position, is specially liable to injury cannot be doubted, but I shall hope to show that the most important factor in determining injury to the bowel is that the injury should be received in the lower half of the abdominal cavity, and, this being the case, that the large bowel in some situations is quite as liable to be injured as the small.

In the series of twenty-one cases under consideration, the rent was situated in the small intestine in sixteen; in the large, in five instances. This proportion may be incorrect, from the small number of cases under investigation, as I am inclined to think is the case with Curtis's numbers; but I will only say with regard to the present series that the observation extends over ten years, and has been made on the material derived from a large city, hence it has at any rate some definite value. As will be seen later, the large bowel was, however, injured in two cases as the result of abnormal mobility due to elongation of the transverse mesocolon, and although this places the two cases in the same category as injuries of the small gut, yet it must be borne in mind that a U-shaped colon is a fairly common condition in the subjects of chronic constipation or omental herniae.

The actual localization of the injuries was as follows:

Duodenum, one, retroperitoneal, five inches from pylorus.

Jejunum, six, sixteen inches from pylorus; twenty and thirty inches from pylorus; four feet from pylorus; six feet two inches from pylorus; eight feet from pylorus; ten feet ten inches from pylorus.

Ileum, seven, twelve feet ten inches from the cæcum; three feet eight inches from the cæcum; one foot six inches from the cæcum; one foot from the cæcum; nine inches from the cæcum; six inches from the cæcum; distance not determined.

Colon, five, junction of ascending colon and cæcum; as-

cending colon, lower part; transverse colon, two; sigmoid colon.

Small Intestine, two, actual point of injury not determined.

Locality in which the Occasioning Violence was exerted.—In nine cases the exact point of impact was indicated by a local bruise or abrasion, and in eight of these the seat of injury was situated below the level of the umbilicus. In three cases it is definitely stated that no bruise existed, but in one of these (a buffer accident) a local, tender spot below the umbilicus indicated the point of injury, and in the other two (the result of horse-kicks) the history definitely localized the point struck as just within the anterior superior iliac spine and below the umbilicus, respectively.

In seven cases no mention is made of a bruise or abrasion; in one of these, however, a definite tender spot above the pubes was stated to have been that struck by the horse's shoe; in five (run over, fall from van, pinning by van pole, blow from falling box, fall with man across belly) no mention is made of either local bruising or tenderness, and in one (horse-kick) it is definitely stated that neither bruising nor tenderness existed.

In the case of subperitoneal injury to the duodenum cellular emphysema indicated broadly the locality of the rupture.

Consideration of the above points shows that the actual determining elements as to the part of the intestinal tube likely to be injured are that the violence should be exerted on that part of the belly cavity supported by a bony wall posteriorly, and, hence, that the bowel to be injured should either be fixed in the lower half of the abdomen or possess a sufficiently long mesentery to lie in that region.

Examination shows that a very large majority of the injuries of the small intestine were either to that portion of the ileum always situated in the iliac or hypogastric regions, or to those portions of the ileum or jejunum normally provided with the longest mesentery, thus only two cases of injury to the jejunum were within two feet of the pylorus.

In the case of the large intestine these points are still more strongly marked; thus, one injury is to the junction of ascending colon and caecum; one to the lower part of the ascending colon; one to the sigmoid colon, parts always situated in the lower half of the abdomen; and the other two were of the transverse colon; in each case the colon being of the U-shaped arrangement, and situated just above the pubes, and therefore in the dangerous area.

The localization of the one injury to the duodenum can clearly also be ascribed to the locality in which the violence was exerted.

Fixation of the bowel is then only to be regarded as of secondary importance, as preventing the escape of any part by gliding away on the application of violence, while length of mesentery and consequent freedom as to location, whether normal, as in the case of the small intestine, or acquired, as in the case of the U-colons, is of greater importance, as allowing any given portion of the bowel to lie in the dangerous area. In making this general statement, of course, exception is made to the rare instances of rupture of the duodeno-jejunal junction as a result of falls from a height to the feet.

Speaking broadly, I think it may be with certainty affirmed that blows over the abdomen, above the level of the umbilicus, are very unlikely to cause a rupture of the intestine, unless the violence be so directed as to allow the gut to be directly compressed against the spinal column, a matter of some rarity, and, secondly, that if blows so directed are received, an injury to the mesentery or omentum is at least equally probable as one to the bowel itself.

Violence applied to the loins is unlikely to be dangerous to any part of the intestine, except the posterior aspect of the colon or duodenum.

The column of the table devoted to the actual nature of the rent affords little new information, but we find examples of every form of the injury before described; thus, in two cases the rents were multiple, in two the bowel had undergone complete transverse division, two were transverse, seven

longitudinal rents, and in seven cases the rupture took the form of a contused hole, varying in size between a minute opening, sufficient to allow the escape of fluid, to one the size of a threepenny piece, surrounded by a considerable area of ecchymosis. In two cases the direction of the rent is not stated.

On the column devoted to the intestinal contents found in the belly at the time of operation I should like, however, to make one remark. Since the time of the classical experiments of Travers we have been well acquainted with the facts that contraction of the muscular coats and eversion of the mucous membrane tend to prevent the escape of intestinal contents, yet the term *fæcal extravasation* is often made use of in speaking of these injuries. Examination of our table shows that in no case did the amount of actual *fæcal* matter deserve such a significant term. In the majority peritoneal infection would be a more fitting description of what had occurred. I mention this, however, not so much as a matter of importance in description as to draw a comparison with the different state of affairs which exists when an opening in the bowel or stomach is the result of the perforation of an ulcer, in which case, from the different nature of the opening, escape of intestinal contents is a prominent feature, and consequently free fluid and gas in the belly give rise to early and well-marked clinical signs absent in most cases of traumatic rupture.

Case VII, in which a secondary operation was done on the third day in consequence of signs leading to the belief that the suture was incompetent, as was indeed the case, throws an illustrative light on this point, since, at the primary operation, only blood is spoken of as found in the peritoneal cavity, while at the second operation a considerable amount of intestinal contents is noted to have escaped from an ulcerating suture hole.

Table II is devoted to a tabular list of the symptoms observed, and, although they offer little diagnostic help, I will shortly analyze them before proceeding to the questions of diagnosis, prognosis, and treatment.

(1) *Shock*.—The degree of shock, as in all serious abdominal injuries, was very variable; in six cases it was severe, being spoken of as "collapse" at the time of admission, and two patients were rendered temporarily unconscious as a result of the injury. On the other hand, in eight cases it is reported as "slight"; in three no mention is made of it as a prominent symptom; and in three it is definitely stated that "no shock" was evident at the time of admission. A certain degree of pallor, often marked and accompanied by sweating, is, however, in my experience, a common condition.

(2) *Abdominal Pain*.—This is a constant sign, but not always continuous, and often not severe. As a rule, the patients came under observation at intervals varying between three-quarters of an hour and four hours after the accidents. Three patients offered no opportunity of observation on this point, since they were admitted on the second day or later.

Early pain is noted in seventeen cases, but in six of these it was not severe, and in three of the remainder it subsided rapidly, to reappear, in two instances, at the end of twenty-four hours, and in a third on the third day,—that is to say, with the development of signs of inflammation. In two cases, again, early tenderness and rigidity were more prominent symptoms than actual pain.

In only two cases is the pain definitely described as "severe," but it must be remembered that in at least six of the cases shock was a marked feature on admission and for some time later.

Variability of degree in this symptom, in the early stages, is to be ascribed to the relative amount of injury to surrounding structures, and the degree of severity of the shock present; in the later stage, when pain depends on the development of inflammatory changes, the want of uniformity corresponds to what is seen in other cases of peritoneal septicæmia.

(3) *Rigidity and Immobility of the Abdominal Wall*.—Both these signs may be regarded as almost constant, but they are naturally not pathognomonic to the injury.

On examination of the table we find that early rigidity was present in thirteen of the cases,—that is, two to four hours after the injury,—in four cases there was no rigidity on admission, and this sign only developed some hours later (thus seven to eighteen hours). In three cases the respiratory movements are described as good. Three patients came under observation on the second, third, and fifth days, respectively; in all the abdomen was rigid on admission.

One or two remarks may, however, be made on these signs, first, the degree of rigidity is apt to vary somewhat frequently during the course of the early hours, and, secondly, the cessation of abdominal respiratory movement gradually follows the development of rigidity, movement persisting in many cases in the upper segment of the belly wall for some time. The latter rigidity is more constant, and accompanied by a considerable increase in the frequency of the respirations; these signs are to be regarded, however, rather as indicative of the development of peritoneal septicæmia than of localization of the injury to the bowel.

(4) *Abdominal Distension*.—This is rarely seen in the early stages, and develops only with the advent of peritoneal septicæmia. In one case it was, however, noted on admission a few hours after the injury; in a second, after a lapse of ten hours; and in a third, after eighteen hours. In all the remainder it was absent, unless the patient lived long enough to develop general evidence of peritoneal septicæmia.

(5) *Abdominal Tenderness*.—In two cases this is mentioned as absent, and in five there is no record of its presence; none the less, it is probably to be regarded as a constant sign, its value being, however, detracted from by the fact that the injury usually present to the abdominal wall often obscures its significance as evidence of injury to deeper structures. In the later stages, it is only useful as a sign of peritoneal septicæmia, assuming a wide distribution and being of little aid as a means of localization.

(6) *Signs on Percussion*.—These are of undoubted value, but, unfortunately, the material at my disposal does not give

very full details. In five no mention is made of the conditions present; in six it is definitely stated that neither dulness nor tympanites was present; in four extensive areas of deficiency of resonance, fixed in position, and most commonly in one or other flank, are described; in four definite local areas of small extent were present; and in one there was emphysema of the flank; in the latter the liver dulness was absent, this being the case of subperitoneal rupture of the duodenum, and the only case in which the latter sign was present.

Of the two variations in local resonance I regard the less extensive as of greater importance; it is to be explained by the local infection produced by the rupture, and is due to effusion and the development of plastic lymph producing early adhesions, and the experience gained by the abdominal sections shows this to be a very early occurrence, at first localized to the seat of injury. The larger areas of dulness are to be explained in another way, and are due to the contraction and collapse of large segments of the small bowel, almost invariably accompanying these injuries. Such contraction may, however, follow other and severe blow or injury to the abdomen: thus I have seen it marked in a case of rupture of the liver and in other injuries, in which the gut itself escaped gross damage. The importance of the sign depends rather on its fixity, which, as indicating its independence of the presence of free fluid in the belly, is an important exclusion sign, since ruptures of the intestine, excluding those accompanied by rent of the mesentery, are rarely the cause of free haemorrhage, and, as has already been shown, are not followed by free escape of intestinal fluid into the peritoneal cavity.

Tympanites is, as a rule, slight and variable, and can scarcely be regarded as a sign of any diagnostic importance. Absence of liver dulness is very rare.

Cellular emphysema was only twice present, once in the left flank, in the case of ruptured duodenum, and once was only discovered by the abdominal section not having passed the limits of the ascending mesocolon. In the first it was an

important diagnostic sign, and in the second would no doubt have been of diagnostic aid, had the patient not been operated upon before it had had time to extend freely. Its significance is undoubted as pointing to injury of the bowel beyond the limits of the peritoneal coat.

I would again advert, under this heading, to the great difference noted in this class of case, and that in which the perforation is secondary to ulceration, in which latter escape of intestinal contents often gives rise to signs not only of free fluid, but also of gas in the abdominal cavity.

(7) *Pulse and Temperature.*—On these points I may be brief. In all cases the pulse shows a steady tendency to rise in frequency and to lose in strength, practically in an identical manner to that in which it behaves in other cases of peritoneal septicæmia. I shall again advert to this sign as the most important single one in the question of deciding on abdominal exploration.

The bodily temperature is usually low soon after the injury, sometimes reaching the extreme shock limit; later it tends to rise, but the rise is often not striking, amounting to 101° to 102° F. at the most.

Some remarks as to the frequency of respiration have already been made under the heading of abdominal rigidity and immobility, and its twofold significance adverted to.

(8) Lastly, certain other symptoms need to be mentioned, although the cases under consideration offer little information on them. Only one patient, a young boy, expressed an urgent desire to defecate shortly after the occurrence of the injury, and in none is the passage of blood or the presence of tenesmus mentioned. None the less, these signs, if present, may be of definite importance.

Diagnosis.—Consideration of the above analysis of the symptoms supports the view that the diagnosis of rupture of the intestine must, in the great majority of cases, be made by the method of exclusion, and then, in view of the necessity of prompt action, often needs the evidence afforded by an abdominal section to confirm it.

In a case of severe abdominal injury our first care must, therefore, be to exclude the possibility of injury to either of the solid viscera, each of which may be said to possess its early characteristic signs, also possible rupture of the urinary bladder, which often suffers from an injury capable of producing a rupture of the intestine.

The history may aid us as to the actual nature of the violence, which was probably such as to affect a strictly localized area, and as to the exact spot upon which the violence was exerted, while the latter point may be further evidenced by external marks of injury, and the importance of the localization of the causative violence to an area below the umbilicus, in many cases, I hope I have made clear.

Secondly, general symptoms, such as shock, pain, and vomiting, combined with local signs, such as localized tenderness, early rigidity and immobility of the abdominal parietes, and the presence of fixed local areas of dulness, either small, as possibly indicating the locality of the injury, or large and fixed, as indicating collapse of bowel but not the presence of free fluid, will be of aid.

Thirdly, special signs pathognomonic of intestinal injury, such as cellular emphysema, localizing the injury to the uncovered portions of the duodenum or colon, or possibly free gas in the peritoneal cavity, may be present.

Fourthly, the presence of any of these signs with a rising pulse above 100 will be indications for an abdominal exploration.

In closing these remarks it may be of interest to point out that, in spite of careful observation on the above lines, we may occasionally open the abdomen in cases where interference is of little use, and would have been better avoided.

As an instance of this I might mention a case, lately under my care, of a boy, aged fourteen, who had been run over. On admission the boy was pale, sweating, with a pulse of 90, and a temperature of 97.5° F.

There was a mark of the wheel over the left great trochanter,

and another graze over the right anterior superior spine, apparently indicating that the wheel had passed obliquely over the pelvis and lower abdomen. The lower part of the abdomen moved little, and there was some rigidity of the wall. A catheter passed brought off some clear normal urine, and no evidence of fractured pelvis could be made out. After a few hours' stay in bed the boy's condition became worse, his pulse rose to over 100, and at the same time local tenderness and dulness developed above the pubes and in the right iliac fossa. It was thought better to explore the abdomen four hours after admission. A median incision below the umbilicus, however, disclosed the cause of the tenderness and dulness as an extraperitoneal haemorrhage in the cavum Retzii, and when the peritoneum was opened the cavity was found normal, except for the presence of a small amount of blood-stained fluid. My attention was, therefore, again directed to the bladder, which had been put out of court as a result of the clear urine which had been readily drawn off. An assistant passed a silver catheter for me, which, in place of entering the bladder, passed into a quantity of blood-infiltrated tissue at its base towards the bottom of Douglas's pouch.

An incision carried deeply into the perineum now entered a cavity full of blood-clot, and the catheter was found to escape from a lateral rent of the urethra at the back of the membranous portion. Careful examination by both wounds failed to enable us to discover a fracture of the pelvis, although I still think one must have existed. The abdominal wound was closed, the perineal kept open with a small plug. The after-course was in all respects satisfactory, the boy rapidly improved, and the wound in the perineum healed in ten days. Little urine escaped, and as the rupture was an incomplete one, no contraction of the lumen of the urethra took place.

This case shows how one may be misled by the use of the complex of symptoms above referred to, but may, I think, fairly be considered an unusual one.

A second, of a somewhat more purely abdominal character, may be mentioned; in this, a man aged twenty-four, while riding down a hill on a bicycle, ran against the tail-board of a van which caught him across the epigastrium; he was taken home in a cab,

and during the night vomited frequently, bringing up, he himself said, a considerable quantity of blood.

He was admitted into the hospital on the following day; the face was pale, the pulse full and strong, 80 to the minute, respiration thoracic and hurried. He complained of pain, increased by deep inspiration, and of great tenderness in the epigastrium. There was no distention, but vomiting followed the taking of any nourishment. I was inclined to suspect an injury to the duodenum on the following grounds: seat of injury, early vomiting, possibly in part of blood, and the local pain and tenderness. The man so steadily improved, however, after being placed in bed that it was decided not to interfere with him, and in ten days he was allowed to go home. On the fortieth day after the accident I saw him again, and found that a pancreatic cyst had developed, which was subsequently successfully drained.

Diagnosis from Rupture of the Mesentery.—A definite diagnosis between simple rupture of the intestine and rupture of the mesentery is often impossible, since the two conditions may be present together. One sign, however, is of definite value in localizing injury to the mesentery,—viz., the presence of a large quantity of free blood in the peritoneal cavity. As already mentioned, uncomplicated ruptures of the intestine are rarely accompanied by free haemorrhage, while this always occurs with mesenteric rents. The difficulty, of course, arises when the injury has been inflicted in certain regions of excluding injury to the solid viscera, but if this can be done, and it can be shown that the injury was inflicted in a region in which the intestine is rarely injured, rent of the mesentery may at least be regarded as possible.

During the period under review three cases of rupture of the mesentery came under treatment at St. Thomas's Hospital; all three were the result of buffer accidents, a not very common cause of rupture of the intestine, and in all three a large quantity of fluid in the peritoneal cavity was a prominent sign. All three showed evidence of unusually severe shock, two dying in a few hours, and never rallying sufficiently to allow of any operation being undertaken, while the

third succumbed twenty-two hours after an abdominal exploration and suture of the rents. In one case two pints of blood were found in the peritoneal cavity at the post-mortem examination, in the second four pints were found, while in the third (that operated upon) a very large amount of blood was evacuated prior to the suture of the rents, and six ounces of blood were still present when the post-mortem examination was performed.

The most important points in the history of such cases would, therefore, seem the localization of the occasioning violence between the levels likely to account for rupture of the liver and spleen above and of the intestine below, and also as accessory the fact that the violence, as a rule, is not of a nature to affect a strictly local area of small extent. Thus Mr. Pitts (*St. Thomas's Hospital Reports*, Vol. xxvi, p. 93), in describing two of these cases, says, "The violence is usually a crush or gliding force, such as a wheel passing over the abdomen."

Prognosis.—As to prognosis in general, considering that up to ten years ago this injury was regarded as a mortal one, the results obtained in the twenty acutely coursing cases must be regarded as highly satisfactory. Of the whole number seventeen died and three recovered,—or 15 per cent.

Of the whole twenty, however, only fifteen were operated upon, with the same number of successes,—or 20 per cent.

A fourth case, Mr. Battle's (*Lancet*, Vol. ii, 1898, p. 1548), might, moreover, be almost regarded as an immediate success, since his death on the twenty-fifth day, from a sub-diaphragmatic abscess, was probably the result of the unfortunate accident of his belly bursting open on the tenth day, during a fit of coughing, for up to that time the progress of the case was all that could be desired.

Sixteen of the twenty ruptures implicated the small intestine; of these two—or 12.8 per cent.—recovered.

The remaining four were of the large bowel, and of these one—or 25 per cent.—recovered.

Average Duration of Life in the Fatal Cases.—In the whole sixteen this amounted to fifty-nine hours twenty-two minutes, omitting one case, which lived twenty-five days. Four other cases, however, lived four, five, six, and nine days respectively, and if these be subtracted also, the average duration of life of the remaining eleven amounts to just forty-eight hours.

In the twelve cases operated upon, the average duration of life amounted to forty-four hours and forty minutes.

In the five cases dying without operation, the average duration of life was eighty-two hours and thirty-six minutes.

If the large and small intestine cases are separated, we find that the average duration of life in thirteen small intestine ruptures (omitting the fourteenth case, which lived twenty-five days) amounted to fifty-two hours and forty-six minutes.

In the three cases of rupture of the large intestine, the average duration of life was eighty-eight hours, but one of the three cases accounted for two hundred and eighteen hours.

Consideration of these numbers seems to show that, on the whole, ruptures of the large intestine have a slightly better prognosis than those of the small; that the average duration of life is about the same whether large or small bowel is implicated, and that unsuccessful operative treatment does not materially shorten life.

As to the influence of the amount of time allowed to elapse before the performance of an operation, in the three successful cases this was six and one-half, eight, and twenty-six hours respectively, while the average time which elapsed in the whole fifteen amounted to eighteen hours, with extremes of three and twenty-six hours.

The points which affect the prognosis are, however, far more complicated than the mere time which elapses between the occurrence of rupture and the closure of the rent. First comes the actual extent of the local injury, and the possible coexistence of other visceral damage (in our cases, however,

all the intestinal injuries, except the one accompanied by a fracture of the frontal bone, which probably in no way affected the issue) were uncomplicated. Secondly comes the strength, age, and vitality of the patient, and, most important of all, the capacity possessed by the subject, both local and general, to resist the influence of the peritoneal septicæmia always resulting. Of this capacity we can form no exact notion, except by the comparative rapidity with which symptoms develop, and this may certainly give us some prognostic aid.

Speaking generally, it is clear that a small rent has a better prognosis than a large one, and that a rent of the small intestine is of greater import in some situations than one of the large. This for two reasons: First, the fluid contents of the small intestine more readily infects the peritoneum, and, moreover, in the most dangerous as the most movable area; secondly, because the contents of the large intestine often pass the opening without escaping, and when escape does occur, it is in a less dangerous peritoneal area, because less influenced by the intestinal movements, at any rate, when on the outer aspect of the bowel. Again, a retroperitoneal rupture may lead to the development of a local abscess, and the patient may escape the dangers of peritoneal septicæmia.

One case included in the table, that of rupture of the sigmoid flexure, gives some information as to the possible favorable prognosis in injuries to the colon, and in further illustration of it, I will shortly relate the second case of rupture of the colon on which this paper is founded.

A man, aged twenty-four, was caught between two railway wagons and forcibly turned round and round between them until they came to a stand-still. When released he dropped to the ground, and was brought to the hospital. Superficial contusions only were noted, and, as there were no symptoms pointing to grave injury, he was allowed to return to his home. He was kept in bed by his medical attendant, as he complained of much pain, but there was no sickness or any other sign indicating injury to the intestinal tract. Meanwhile his appearance suggested some

internal mischief, and he had a raised temperature, the thermometer registering an average of 100° F. each evening. He was kept in bed twenty-five days, and then allowed to get up, but this was followed by a severe attack of pain in the right side of the abdomen, and the passage of urine containing a considerable amount of blood. The man was now confined to his bed for a further eight days, during which time he became worse, but the bowels continued to act, there was no sickness, and no more blood was passed with the urine. A tumor began to form in the right half of the abdomen.

On the thirty-fourth day he was admitted into the hospital, when his condition was as follows: There is some emaciation, which has been increasing, the face is thin and flushed, and the patient lies in the supine position with the knees drawn up. A large, tense, ill-defined swelling occupies the right half of the abdomen, extending from just below the costal margin to Poupart's ligament. It is dull on percussion, but the dulness does not extend into the right flank, and there is distinct fluctuation in the lower part of it. The evening temperature is 100° F. The urine contains a trace of albumen, but no blood.

On the thirty-seventh day an anaesthetic was given, and an incision made in the lower part of the tumor in the linea semilunaris; the abdominal wall was rigid and infiltrated, but no pus was met with until the peritoneal cavity was opened. A large, irregular cavity walled in by intestine was found, containing dirty-colored pus, faecal in odor, but containing no distinct faecal lumps. The ascending colon formed the outer limit, and was firmly adherent to the abdominal wall. The cavity was flushed with hot sterilized water, and a drainage-tube inserted, the upper part of the wound being closed with sutures.

When the wound was dressed the next day, there was a considerable amount of discharge of faecal odor, and on each of the following three days there was abundant discharge and obvious faecal matter in small quantities. After this date the discharge lessened in quantity, became gradually less offensive, and no faeces were again seen. The sinus was firmly closed at the end of a month, when the patient left the hospital well, and shortly resumed his occupation.

I think it is evident, from the history and course of this

case, that the original injury of the colon could not have amounted to actual perforation, but rather to such severe contusion that sloughing subsequently took place. Another point of interest lies in the question as to whether the perforation, when it did occur, was intraperitoneal, and safeguarded by such slight peritoneal adhesions that the mere act of getting up caused them to give way; or whether the act of getting up caused a collection of pus in the retroperitoneal space on the surface of the kidney to make its way into the peritoneal cavity. The attack of haematuria seems to point to concomitant injury to the kidney, and probably both injuries must have been in the same region. The absence of any palpable swelling in the loin, where an abscess usually forms subsequently to a retroperitoneal rupture seems in favor of the intraperitoneal theory.

Consideration of the history of the case of rupture of the sigmoid flexure, quoted in the table, is also an argument in favor of the intraperitoneal nature of the injury, since, in that instance, an actual perforation was found, and yet no escape of faecal matter sufficient to give rise to serious signs of septic poisoning took place until after the administration of an enema. It is, moreover, a well-known fact that small punctures of the colon are by no means always followed by the escape of faeces.

Treatment.—The general line of treatment in these injuries is sufficiently set forth in the account of the case forming the preamble of this paper. In the earlier cases included in the tables complete circular resection of the lumen of the bowel was practised, with end-to-end junction, but in the later ones simple suture of the rent sufficed to fulfil all the indications, the union obtained proving uniformly competent even in those ending fatally.

Resection should, therefore, be reserved for those cases only in which actual transverse solution of the continuity of the bowel has occurred, or those in which a segment is irretrievably damaged by contusion or laceration.

Choice of Moment for Operation.—Speaking generally,

this cannot be too early, if the injury is either diagnosed or suspected; none the less, it may be necessary to await reaction from the primary shock, due either to idiosyncrasy, the severity of the injury, or occasionally to the amount of haemorrhage.

From whatever cause due, it may be necessary to combat shock by the application of hot bottles, the administration of stimulants (preferably per rectum), the hypodermic injection of strychnine, and, in severe instances, by the infusion of normal saline solution. The need of care in the exhibition of stimulants when haemorrhage is suspected is obvious.

Selection of Site for Exploratory Incision.—Bearing in mind the usual location of ruptures, a median incision between the umbilicus and the pubes, in or slightly to one or other side of the linea alba, is generally to be preferred for the following reasons: (1) It will not be far removed from the seat of injury; (2) it may avoid the bruised portion of the abdominal parietes; (3) it can be readily extended, and it permits of the most satisfactory subsequent cleansing of the peritoneum.

Indications of the Site of Rupture.—An early localization of this is important, as preventing diffusion of septic matter, which is necessarily the result of lengthy exploration of the abdomen. Preliminary indications are found in the history and possibly in the presence of a local abrasion or bruise. When the belly is opened the following points may be borne in mind:

(a) The discovery of intestinal contents. As already remarked, the escape of chyme or faeces is usually not abundant, and may only be helpful in connection with the points dealt with under the following two headings, and as possessing a characteristic odor.

(b) The presence of plastic lymph. This is developed early, and especially in the neighborhood of the rent. The importance of *b*, *c*, and *d* in the production of certain physical signs has already been dwelt on.

(c) The presence of local peritoneal effusion, often in some quantity, and foul smelling: in the early stages this is also confined to the region of the injury, and is the result of the peritoneal infection.

(d) The presence of blood in small quantity, usually coagulated and in close relationship to the lesion.

(e) The escape of intestinal gases.

(f) The presence of retroperitoneal emphysema, pointing to injury to the colon or duodenum outside the limits of their peritoneal covering.

(g) The possible presence of ecchymoses of the parietal or visceral peritoneum.

Method of Suture.—In all moderate rents, unaccompanied by severe surrounding contusion, simple suture of the opening by Lembert's method is to be preferred.

When surrounding contusion is severe, or complete transverse solution has occurred, resection of a suitable portion of the gut should be followed by closure of the ends of the cut bowel, and the establishment of a lateral union or anastomosis, with Halsted's method of suture. This method is to be preferred by reason of the better results experienced after its use, and the far more satisfactory blood-supply obtained for the line of suture by it. Its only disadvantage is in the question of time, and should the condition of the patient be such as to preclude its use, a Murphy's button or some such mechanical method may be substituted.

Cleansing of the Peritoneum.—The suture completed, the next step is the cleansing of the belly cavity. This is best effected by preliminary dry sponging of the obviously infected area, followed by irrigation, and, if necessary, the protrusion and washing of the small intestine and thorough flushing of the pelvis and various peritoneal fossæ. Irrigation prior to the dry cleansing of the most severely affected area is to be avoided as tending to diffuse septic material.

Drainage.—This is to be avoided, if possible, but if, from the extent of the infection or the special distribution of it, drainage is necessary, a fairly wide gap in the external wound,

and a gauze plug leading down to the region needed, is the most satisfactory method to employ.

After-Treatment.—Shock may need to be met in the same way already indicated in speaking of the primary condition, and it is here, perhaps, that saline infusions are most useful: if necessary, a small amount of alcohol may be added to the saline solution.

Warm water may be allowed by mouth from the time of complete recovery from the anaesthetic; rectal feeding should be relied on for the first twenty-four hours, after this period (in the absence of vomiting) fluid nourishment may be administered by the mouth with safety and advantage.

Morphine should be avoided if possible.

Should distension and sickness herald the advent of septic infection, saline purgation should at once be resorted to as in other cases of peritoneal septicæmia. Sulphate of magnesia may sometimes be retained, even when vomiting is troublesome, by washing out the stomach preliminary to administering each dose. If the suture has been effectively accomplished, I believe there is no fear to be entertained from the administration of a saline purge, while enemata are practically useless in cases of peritoneal septicæma, and a real danger in cases of injury to the large gut, from the amount of mechanical disturbance of the parts which they produce.

ANALYSES OF CASES OF RUPTURE OF THE INTESTINE TREATED IN ST. THOMAS'S HOSPITAL.

TABLE I.—HISTORY AND NATURE OF INJURY.

CASE I.—*Year, 1889. Reference, J. Croft, Clinical Society's Transactions, Vol. xxiii, p. 141.* Male, aged fourteen years. *Nature of violence, kick by horse. External signs of violence, none, but history located blow below umbilicus. Part of bowel affected, small intestine, ileum, point undetermined. Nature of injury to bowel, rupture of under surface, three-eighths inch in diameter; corresponding ecchymosed spot on opposite side of gut. Nature of fluid, etc., found in belly at operation, one and a half ounces turbid-brown fluid of faecal odor. Operation, median abdominal section; resection and end-to-end junction. Result, cured.*

CASE II.—Year, 1889. Male, aged eight years. *Nature of violence*, fall of twelve feet onto anvil. *External signs of violence*, bruising midway between umbilicus and pubes. *Part of bowel affected*, ileum, eighteen inches from cæcum. *Nature of injury to bowel*, lacerated wound of free margin of gut. *Nature of fluid, etc., found in belly at operation*, no mention. *Operation*, median abdominal section; resection and end-to-end junction. *Result*, died.

CASE III.—Year, 1889. Male, aged two years. *Nature of violence*, run over. *External signs of violence*, bruise one-half inch broad on left side of belly, at level of umbilicus. *Part of bowel affected*, jejunum, four feet from pylorus. *Nature of injury to bowel*, complete transverse rupture. *Nature of fluid, etc., found in belly at operation*, no mention, but rupture not found; faeces at post-mortem. *Operation*, abdominal section; rent not discovered. *Result*, died.

CASE IV.—Year, 1890. Reference, St. Thomas's Hospital Reports, Vol. xxi, p. 428. Male, aged sixty-one years. *Nature of violence*, buffer accident. *Part of bowel affected*, ileum, ten feet ten inches from cæcum. *Nature of injury to bowel*, three-eighths inch longitudinal rent at free margin. *Nature of fluid, etc., found in belly at operation*, faeces in hernial sac. *Operation*, section and exploration of hernial sac. *Result*, died.

CASE V.—Year, 1890. Reference, St. Thomas's Hospital Reports, Vol. xxi, p. 428. Male, aged twenty-three years. *Nature of violence*, kick by horse. *External signs of violence*, bruise to left of umbilicus. *Part of bowel affected*, transverse colon. *Nature of injury to bowel*, three-fourths inch longitudinal rent; one inch area of ecchymosis and stripping of coats around. *Nature of fluid, etc., found in belly at operation*, dirty-red foetid fluid. *Operation*, abdominal section, suture of rent, and omental graft. *Result*, died.

CASE VI.—Year, 1892. Reference, St. Thomas's Hospital Reports, Vol. xxii, p. 273. Male, aged sixty-four years. *Nature of violence*, blow by falling box. *Part of bowel affected*, jejunum, sixteen inches from pylorus. *Nature of injury to bowel*, small linear rent; lacerated wound of omentum. *Operation*, none. *Result*, died.

CASE VII.—Year, 1892. Reference, St. Thomas's Hospital Reports, Vol. xxii, p. 273. Male, aged twenty-four years. *Nature of violence*, kick by a horse. *External signs of violence*, median bruise below umbilicus. *Part of bowel affected*, jejunum, in two places, twenty and thirty inches from pylorus. *Nature of injury to bowel*, two complete transverse ruptures three inches apart; a third one foot lower. *Nature of fluid, etc., found in belly at operation*, much blood; second operation, faeces from hole due to ulceration of suture. *Operation*, abdominal section, one end-to-end, and one lateral junction with Senn's plates. *Result*, died.

CASE VIII.—Year, 1894. Reference, St. Thomas's Hospital Reports, Vol. xxiii, p. 355. Male, aged sixty years. *Nature of violence*, fall from van. *Part of bowel affected*, sigmoid flexure. *Nature of injury to bowel*, minute hole, allowing passage of fluid. *Operation*, none. *Result*, died on sixth day.

CASE IX.—Year, 1895. Reference, St. Thomas's Hospital Reports,

Vol. xxiv, p. 373. Male, aged fifty-seven years. *Nature of violence*, run over by cart. *External signs of violence*, bruising in left inguinal region. *Part of bowel affected*, ileum, eleven feet from pylorus. *Nature of injury to bowel*, ragged longitudinal rupture at free margin. *Nature of fluid, etc., found in belly at operation*, no mention. *Operation*, abdominal section; suture of rent. *Result*, died.

CASE X.—Year, 1895. Reference, St. Thomas's Hospital Reports, Vol. xxiv, p. 373. Male, aged twelve years. *Nature of violence*, run over by cart. *Part of bowel affected*, ileum, three feet eight inches from caecum. *Nature of injury to bowel*, transverse rupture with clean edges of one-half inch circumference. *Nature of fluid, etc., found in belly at operation*, blood. *Operation*, abdominal section; resection and end-to-end junction. *Result*, died.

CASE XI.—Year, 1896. Reference, St. Thomas's Hospital Reports, Vol. xxv, p. 369. Male, aged thirty-eight years. *Nature of violence*, kick by horse. *External signs of violence*, no bruise; tender spot just within anterior superior spine of ilium. *Part of bowel affected*, ileo-jejunal junction(?). *Nature of injury to bowel*, transverse rent, starting from mesenteric border and involving one-third of its circumference. *Nature of fluid, etc., found in belly at operation*, sero-purulent fluid. *Operation*, abdominal section; suture. *Result*, died.

CASE XII.—Year, 1897. Reference, St. Thomas's Hospital Reports, Vol. xxvi, p. 365. Male, fifty-two years. *Nature of violence*, fall with man across his belly. *Part of bowel affected*, ileum, nine inches from caecum. *Nature of injury to bowel*, two small rents. *Nature of fluid, etc., found in belly at operation*, faecal matter. *Operation*, abdominal section; suture. *Result*, died.

CASE XIII.—Year, 1897. Reference, St. Thomas's Hospital Reports, Vol. xxvi, p. 366. Male, aged forty-nine years. *Nature of violence*, pinned against wall by van pole. *External signs of violence*, local tenderness in right iliac fossa, part struck. *Part of bowel affected*, jejunum, six feet two inches from pylorus. *Nature of injury to bowel*, rent at free margin one-half inch long. *Operation*, none. *Result*, died.

CASE XIV.—Year, 1897. Reference, St. Thomas's Hospital Reports, Vol. xxvi, pp. 100, 366. Male, aged nineteen years. *Nature of violence*, run over by van. *External signs of violence*, emphysema, right flank. *Part of bowel affected*, duodenum, second part, retroperitoneal two and a half inches from pylorus. *Nature of injury to bowel*, rent one-half inch long. *Nature of fluid, etc., found in belly at operation*, blood; free gas. *Operation*, abdominal exploration. *Result*, died.

CASE XV.—Year, 1898. Reference, St. Thomas's Hospital Reports, Vol. xxvii; see also B. Pitts, Vol. xxvi, p. 93, full account. Male, aged thirty-seven years. *Nature of violence*, kick by horse. *External signs of violence*, local tenderness equal to area of palm of hand above pubes. *Part of bowel affected*, small intestine. *Nature of injury to bowel*, perforation at free border of gut; hole in mesentery admitting little finger. *Nature of fluid, etc., found in belly at operation*, no free fluid; fragments of undigested food. *Operation*, abdominal section; suture. *Result*, cured.

CASE XVI.—Year, 1898. Reference, St. Thomas's Hospital Reports, Vol. xxvii. Male, aged twenty-six years. *Nature of violence*, blow from end of log on sawing machine. *External signs of violence*, graze and abrasion just above and within anterior superior spine of ilium. *Part of bowel affected*, junction of cæcum and ascending colon. *Nature of injury to bowel*, two rents, one of peritoneal coat only, one perforating. *Nature of fluid, etc., found in belly at operation*, muddy-brown, faecal-smelling fluid and blood-clot. *Operation*, abdominal section; suture. *Result*, cured.

CASE XVII.—Year, 1898. Reference, St. Thomas's Hospital Reports, Vol. xxvii. Male, aged sixty-two years. *Nature of violence*, kick by horse. *Part of bowel affected*, transverse colon. *Nature of injury to bowel*, most prominent part of U-loop bruised and small rent near mesenteric border. *Operation*, none. *Result*, died.

CASE XVIII.—Year, 1898. Reference, St. Thomas's Hospital Reports, Vol. xxvii. Male, aged forty-one years. *Nature of violence*, buffer accident. *External signs of violence*, abrasion in right iliac region. *Part of bowel affected*, ileum. *Nature of injury to bowel*, rent equal to a centased hole the size of a threepenny piece. *Nature of fluid, etc., found in belly at operation*, blood and a small quantity of faeces post-mortem. *Operation*, none. *Result*, died.

CASE XIX.—Year, 1898. Reference, St. Thomas's Hospital Reports, Vol. xxvii. Male, aged seven years. *Nature of violence*, fall from window, eight feet, across iron railing. *External signs of violence*, bruise across belly at level of anterior superior spines. *Part of bowel affected*, ileum, six inches from cæcum. *Nature of injury to bowel*, rent admitting finger-tip at free border. *Nature of fluid, etc., found in belly at operation*, one ounce faeces and sero-purulent fluid in pelvis. *Operation*, abdominal section; suture. *Result*, died.

CASE XX.—Year, 1898. Reference, W. H. Battle, *Lancet*, December, 1898, Vol. ii, p. 1548. Male, aged twenty-seven years. *Nature of violence*, run over. *External signs of violence*, abrasions below umbilicus. *Part of bowel affected*, ileum, twelve inches from cæcum. *Nature of injury to bowel*, rent three-eighths of an inch long. *Nature of fluid, etc., found in belly at operation*, semipurulent fluid. *Operation*, abdominal section; suture; wound of abdominal parietes gave way on tenth day. *Result*, died on twenty-fifth day.

CASE XXI.—Year, 1895. Reference, G. H. Makins, St. Thomas's Hospital Reports, 1895, Vol. xxiv, p. 92. Male, aged twenty-four years. *Nature of violence*, caught between passing trucks. *Part of bowel affected*, ascending colon. *Nature of injury to bowel(?)*, severe contusion only, and secondary sloughing. *Nature of fluid, etc., found in belly at operation*, faeces from fistula after operation; pus with faecal odor from abscess. *Operation*, secondary opening of abscess followed by faecal fistula. *Result*, cured.

TABLE II.—SYMPTOMS AND DURATION OF LIFE.

CASE I.—*Part of bowel, ileum.* Male, aged fourteen years. *Shock*, slight; unconscious for a time. *Abdominal pain*, not marked till twenty-four hours after accident. *Vomiting*, vomited three times after medicine; no further sickness when food was stopped; whitish fluid. *Rigidity and immobility of abdominal wall*, rigidity marked. *Distention*, none. *Physical signs on palpation and percussion*, tenderness below umbilicus; dulness in left flank. *Time between occurrence of accident and operation*, twenty-six hours. *Duration of life after operation, cure.* *Duration of life after injury, cure.*

CASE II.—*Part of bowel, ileum.* Male, aged eight years. *Time between occurrence of accident and admission*, two hours. *Shock*, marked; temperature, 97.8° F. *Abdominal pain*, marked on admission. *Vomiting*, commenced one hour after accident and continued up to time of operation; dirty-brown fluid. *Rigidity and immobility of abdominal wall*, rigidity marked. *Distention*, ten hours after accident. *Physical signs on palpation and percussion*, circular patch of dulness, three inches in diameter, to right of median line below umbilicus, here very tender. *Time between occurrence of accident and operation*, twenty-four hours. *Duration of life after operation, seventeen hours.* *Duration of life after injury, forty-one hours.* *Remarks*, wished to defecate immediately after accident.

CASE III.—*Part of bowel, jejunum.* Male, aged two years. *Shock*, collapse; temperature, 97.4° F.; pulse, 140. *Abdominal pain*, pain on decrease of shock. *Vomiting*, occasional before operation. *Rigidity and immobility of abdominal wall*, rigidity marked. *Distention*, on admission. *Physical signs on palpation and percussion*, local dull area below and to left of umbilicus; tenderness of left side of belly. *Time between occurrence of accident and operation*, seven hours. *Duration of life after operation*, fifteen hours. *Duration of life after injury, twenty-two hours.*

CASE IV.—*Part of bowel, ileum.* Male, aged sixty-one years. *Shock*, slight. *Vomiting*, commenced at the end of twenty-four hours. *Rigidity and immobility of abdominal wall*, rigidity marked. *Distention*, no mention. *Physical signs on palpation and percussion*, great tenderness of hernial sac. *Duration of life after injury, twenty-eight hours.*

CASE V.—*Part of bowel, transverse colon.* Male, aged twenty-three years. *Time between occurrence of accident and admission*, two hours. *Shock*, collapse. *Vomiting*, twice during the six hours prior to operation. *Rigidity and immobility of abdominal wall*, rigidity marked. *Distention*, no mention. *Physical signs on palpation and percussion*, great tenderness. *Time between occurrence of accident and operation*, six hours. *Duration of life after operation*, eighteen hours. *Duration of life after injury, twenty-four hours.*

CASE VI.—*Part of bowel, jejunum.* Male, aged sixty-four years. *Shock*, slight. *Vomiting*, slight. *Rigidity and immobility of abdominal wall*, rigidity marked. *Distention*, none. *Time between occurrence of accident and operation*, six hours. *Duration of life after injury, thirty hours.*

CASE VII.—*Part of bowel*, jejunum. Male, aged twenty-four years. Shock, collapse. Vomiting, vomited food soon after admission. Rigidity and immobility of abdominal wall, rigidity marked. Distention, on admission. Physical signs on palpation and percussion, tender; dull except below ensiform cartilage and in left flank. Time between occurrence of accident and operation, seven hours. Duration of life after operation, five days and seventeen hours. Duration of life after injury, six days.

CASE VIII.—*Part of bowel*, sigmoid colon. Male, aged sixty years. Time between occurrence of accident and admission, five days. Vomiting, frequent before admission. Rigidity and immobility of abdominal wall, rigidity marked. Distention, on admission, on fifth day. Physical signs on palpation and percussion, tender; distention in right iliac region. Duration of life after injury, nine days.

CASE IX.—*Part of bowel*, ileum. Male, aged fifty-seven years. Shock, slight. Abdominal pain, slight on admission. Vomiting, vomited contents of stomach eighteen hours after admission. Rigidity and immobility of abdominal wall, belly flaccid until eighteen hours after injury. Distention, eighteen hours after accident. Physical signs on palpation and percussion, fixed dulness in left flank; tenderness in left inguinal region. Time between occurrence of accident and operation, twenty hours. Duration of life after operation, four hours. Duration of life after injury, twenty-four hours.

CASE X.—*Part of bowel*, ileum. Male, aged twelve years. Time between occurrence of accident and admission, twenty-four hours. Shock, slight. Abdominal pain, little pain for first twenty-four hours. Vomiting, none during first twenty-four hours, then frequent. Rigidity and immobility of abdominal wall, no note; admitted second day. Distention, no mention. Physical signs on palpation and percussion, no dulness. Time between occurrence of accident and operation, twenty-four hours. Duration of life after operation, thirty-six hours. Duration of life after injury, sixty hours.

CASE XI.—*Part of bowel*, small intestine. Male, aged thirty-eight years. Time between occurrence of accident and admission, two hours. Shock, unconscious at first; little shock on admission. Abdominal pain, little pain. Vomiting, constant and immediate, soon becoming faecal. Rigidity and immobility of abdominal wall, no note. Distention, no mention. Physical signs on palpation and percussion, impairment of resonance in left flank; tender just within right anterior superior spine. Time between occurrence of accident and operation, five hours. Duration of life after operation, twenty hours. Duration of life after injury, twenty-five hours.

CASE XII.—*Part of bowel*, ileum. Male, aged fifty-two years. Time between occurrence of accident and admission, three days. Abdominal pain, pain. Vomiting, commenced after twenty-four hours, then constant until operation. Rigidity and immobility of abdominal wall, rigidity marked on third day, when admitted. Distention, on admission, on third day. Physical signs on palpation and percussion, tender; no dulness third day. Time between occurrence of accident and operation, third day.

Duration of life after operation, forty-eight hours. *Duration of life after injury*, five days.

CASE XIII.—*Part of bowel*, jejunum. Male, aged forty-nine years. *Time between occurrence of accident and admission*, three days. *Shock*, little. *Abdominal pain*, pain on admission ceased, to commence again on third day. *Vomiting*, once after accident, again on third day, and on fourth day constant till death. *Rigidity and immobility of abdominal wall*, rigidity. *Distention*, on fourth day. *Physical signs on palpation and percussion*, dulness and tenderness in left iliac fossa. *Duration of life after injury*, fourth day.

CASE XIV.—*Part of bowel*, duodenum. Male, aged nineteen years. *Time between occurrence of accident and admission*, two hours. *Shock*, severe. *Abdominal pain*, severe. *Vomiting*, none. *Rigidity and immobility of abdominal wall*, no note. *Distention*, on admission. *Physical signs on palpation and percussion*, emphysema of flank and serotum; absence of liver dulness. *Time between occurrence of accident and operation*, three hours. *Duration of life after operation*, nine hours. *Duration of life after injury*, twelve hours.

CASE XV.—*Part of bowel*, small intestine. Male, aged thirty-seven years. *Time between occurrence of accident and admission*, forty-five minutes. *Shock*, none. *Abdominal pain*, considerable on admission. *Vomiting*, immediate, bile-stained fluid; once after operation. *Rigidity and immobility of abdominal wall*, rigidity marked. *Distention*, no mention. *Physical signs on palpation and percussion*, tender above pubes and in left iliac fossa; tender area dull. *Time between occurrence of accident and operation*, six hours. *Duration of life after operation*, eure. *Duration of life after injury*, eure.

CASE XVI.—*Part of bowel*, junction of cæcum and colon. Male, aged twenty-six years. *Time between occurrence of accident and admission*, forty-five minutes. *Shock*, severe. *Abdominal pain*, moderate pain. *Vomiting*, immediate and frequent until operation. *Rigidity and immobility of abdominal wall*, rigidity marked. *Distention*, slight. *Time between occurrence of accident and operation*, eight hours. *Duration of life after operation*, eure. *Duration of life after injury*, eure.

CASE XVII.—*Part of bowel*, transverse colon. Male, aged sixty-two years. *Time between occurrence of accident and admission*, two hours. *Shock*, severe. *Abdominal pain*, severe pain. *Vomiting*, none. *Rigidity and immobility of abdominal wall*, respiratory movements good. *Distention*, none. *Physical signs on palpation and percussion*, neither local dulness nor tenderness. *Duration of life after injury*, less than twenty-four hours.

CASE XVIII.—*Part of bowel*, ileum. Male, aged forty-one years. *Time between occurrence of accident and admission*, two hours. *Shock*, none. *Abdominal pain*, pain in lower abdomen. *Vomiting*, nausea but no vomiting. *Rigidity and immobility of abdominal wall*, respiratory movements good. *Distention*, none. *Physical signs on palpation and percussion*, tenderness at site of abrasion; no dulness. *Duration of life after injury*, forty-eight hours.

CASE XIX.—*Part of bowel, ileum.* Male, aged seven years. *Time between occurrence of accident and admission,* four hours. *Shock,* slight; pulse, 120; temperature, 97° F. *Abdominal pain,* slight pain. *Vomiting,* retched, but no vomiting until end of twenty-four hours. *Rigidity and immobility of abdominal wall,* rigidity not present till seven hours after accident. *Distention,* none. *Physical signs on palpation and percussion,* no local tenderness or dulness. *Time between occurrence of accident and operation,* twenty-six hours. *Duration of life after operation,* ten hours. *Duration of life after injury,* thirty-six hours.

CASE XX.—*Part of bowel, ileum.* Male, aged twenty-seven years. *Time between occurrence of accident and admission,* two hours. *Shock,* drunk. *Abdominal pain,* not marked. *Vomiting,* commenced soon after accident, and continued three days after operation. *Rigidity and immobility of abdominal wall,* rigidity marked. *Distention,* none. *Physical signs on palpation and percussion,* tenderness; no dulness. *Time between occurrence of accident and operation,* twenty hours. *Duration of life after operation,* twenty-four days. *Duration of life after injury,* twenty-five days.

